PHACONEURA (HOMOPTERA: MEENOPLIDAE) ATTENDED BY ANTS OF THE GENUS *PARATRECHINA* (HYMENOPTERA: FORMICIDAE) IN CAVES

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Abstract

Cave inhabiting species of *Phaconeura* Kirkaldy from the Kimberley and Cape Range, Western Australia, are attended by ants of the genus *Paratrechina* Motschoulsky, which themselves probably are especially adapted for cave life.

Introduction

The Australian tropics have been found recently to contain a diverse troglobitic fauna, in both humid (Howarth 1988) and arid (Humphreys 1993b) regions. One of the more diverse groups of animals found in the caves is planthoppers (Homoptera) of the fulgoroid families Cixiidae (especially the genus *Solonaima* Kirkaldy: Hoch 1988, Hoch and Howarth 1989a, 1989b, 1989c) and Meenoplidae (especially species of the genus *Phaconeura* Kirkaldy: Hoch 1990, 1993). By 1989 North Queensland had recorded the highest concentration of cave-adapted Fulgoroidea in the world (Hoch and Asche 1989).

Until 1990 only one cave adapted meenoplid was known in Australia, *Phaconeura pluto* Fennah from Nambung National Park in Western Australia (Fennah 1973). Subsequently four new species of *Phaconeura* were described from North Queensland caves (Hoch 1990) and another (Hoch 1993) from caves in the Cape Range of Western Australia (Humphreys 1993a, 1993b). Since then several more undescribed cavernicolous species of *Phaconeura* (H. Hoch, pers. comm.) have been found in the area of Cape Range and in the Kimberley. Cave-adapted meenoplids have been found exclusively in limestone caves in Australia, whereas elsewhere they are only known from lava tubes (Hoch 1990) in the Canary Islands (Remane and Hoch 1988) and Western Samoa (Hoch and Asche 1988). Ant-Homoptera associations are well known (Schaefer 1987, Bourgoin in press) but have so far been reported only from epigean species.

The distribution of obligatory cave dwelling (troglobitic) apterous species of *Phaconeura,* between isolated but neighbouring towers of the Chillagoe Karst, led Howarth (pers. comm. in Hoch 1990) to presume the species to be attended by ants in order to explain their dispersal; species of *Paratrechina* Motschoulsky occur in these caves (Howarth 1988). Here support is provided for Howarth's supposition by reporting the attendance of meenoplids by ants in caves in the Kimberley and Cape Range, Western Australia.

Observations

During surveys of cave fauna in northwestern Australia (Humphreys 1993c, 1995) meenoplids were found to occur widely but the observations reported here are from two main caves in the Kimberley and Cape Range.

Cave KNI-9 is in the Ningbing Range, Kimberley (15°17'S; 128°37'E), formed in the exposed Devonian reef system. The cave is mainly horizontal and is *ca* 136 m long; it is one of many in the southern Ningbing Range.

Cave C-29 is in Cape Range, Carnarvon Basin (22°06'S; 114°01'E) in an anticline of Miocene limestones. The cave comprises a 24 m deep chamber from which two passages extend for 105 m (R. D. Brooks, pers. comm.) and where the ants and meenoplids were found. The chamber is often dry but seepages sometimes moisten the cave soil at the extremities of the passages.

In the caves meenoplids are typically found wandering over the substrate or feeding on fine growing roots of undetermined plants, probably often *Ficus*, usually on damp soil covered surfaces. However, at two places in cave KNI-9, nymphs of a yet undescribed species of *Phaconeura* (H. Hoch, pers. comm. 1994) were found in groups on roots, either on the surface or in soil cavities, with ants in attendance which appeared to groom the nymphs. The ants became agitated when disturbed and began to collect the nymphs, both from the surface roots and the underground cells, and transport them away from the area. Within several minutes after disturbance no nymphs were left in the area. In Cape Range (C-29) nymphs of *Phaconeura* sp. were found in groups on roots, either on the surface or in soil cavities, with ants in attendance (A. Amarkey, pers. comm.); nymphs cannot be determined to species but *Phaconeura proserpina* Hoch is known from nearby caves.

In both areas the ants were species of *Paratrechina*, a genus that requires full revision before species-level identification will be possible (S. Shattuck, pers. comm. 1994). These ants have very small eyes and it "seems likely that this is one of the few ants known that is especially adapted for cave life" (S. Shattuck, pers. comm. 1995). Small-eyed species of *Paratrechina* have also been collected from Cutta Cutta Cave, N.T., in the same parts of the cave as *Phaconeura* sp. indet. (W. Binks, R. D. Brooks and B. Vine, pers. comm.), although no clear association was reported.

Paratrechina is widely distributed, although much more common in eastern and northern areas of Australia (S. Shattuck, pers comm. 1994). While *Paratrechina* have been considered to be opportunists (Reichel and Andersen 1996), members of the genus are known to attend Hemiptera. The sugarcane mealybug *Saccharicoccus sacchari* (Cockerell) (Pseudococcidae), is consistently attended both above and below ground by ants, including *Paratrechina* sp. prob. *vaga* (Forel), which were observed carrying the mealybugs underground (Carver *et al.* 1987). In addition *Paratrechina obscura* Mayr was involved in behaviour - removing mummies from nodes - that has been interpreted as mutualistic (De Barro 1990).

Microclimate

The meenoplids were found in those parts of the cave that contained root systems and where the air was nearly saturated with water (Table 1). In KNI-9 these areas were in high parts of the cave where the warmer air collected. In C-29 the meenoplids were found at the extremities of the tunnels where humidity is greatest. The fauna of tropical caves, even in arid zones, is dependent on high moisture levels (Howarth 1980, Humphreys and Collis 1990, Humphreys 1991, Weinstein 1994).

Table 1. The temperature (°C) and relative humidity (%) associated with cave KNI-9 in May and June 1994. The mean is given with its standard deviation in parentheses. Temperature and relative humidity were spot measured using a whirling hygrometer (Brannan, England).

Location	n	°C	%
Outside cave	3	29.2 (1.72)	44 (16)
Inside cave: no meenoplids	26	25.9 (1.76)	86 (15.9)
meenoplids	3	27.3 (0.46)	98 (0.6)

Discussion

The fauna found in the Kimberley caves is not predominantly troglobitic, unlike that of tropical caves elsewhere in Australia (Howarth 1988, Humphreys 1993b, 1993c). Only one of 14 species (7%) associated with the meenoplids was troglomorphic, that is it had morphological adaptations associate with cave life, namely Blattodea [*Nocticola brooksi* Roth (Blattodea: Nocticolidae)]. By contrast, arid Cape Range contains a very rich cave fauna with rainforest affinities (Humphreys 1993b, 1993c) and, of the species known from C-29, half (n=8) were highly troglomorphic, namely *Nocticola flabella* Roth (Blattodea: Nocticolidae), *Ngamarlanguia luisae* Rentz & Su (Orthoptera: Gryllidae: Nemobiinae), *Stygiochiropus communis* Humphreys & Shear (Diplopoda: Paradoxosomatidae) and *Draculoides vinei* (Harvey) (Arachnida: Schizomida).

Cave restricted animals ultimately feed on photosynthetically derived energy, except in special cases of chemoautotrophy. The energy is transferred to the cave largely by water, as fine or gross plant material, by animals, such as bats and rhaphidophorid cave crickets foraging outside the cave, and by plants by means of root growth and sap transport. Cave restricted animals may eat the roots alive or dead, feed on root exudates or directly on the sap, as do meenoplids. The presence in these caves of a two level assemblage of terrestrial species utilizing plant roots may be the first step to recognising more complex root feeding assemblages in caves, as found recently for

aquatic invertebrates for which rich assemblages are supported by root mats in caves (Jasinska *et al.* 1996).

Acknowledgments

It is my pleasure to acknowledge the identifications and comments of Hannelore Hoch and Steve Shattuck and the invaluable support of Julianne Waldock, Darren Brooks and Brian Vine. Facilities were made available by Bob Shackles, Officer in Charge, Frank Wise Institute for Tropical Agricultural Research in Kununurra. Professor Dr Hannelore Hoch and Dr M. B. Malipatil identified Emesinae. Field work was funded under the National Estate Grants Scheme.

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